

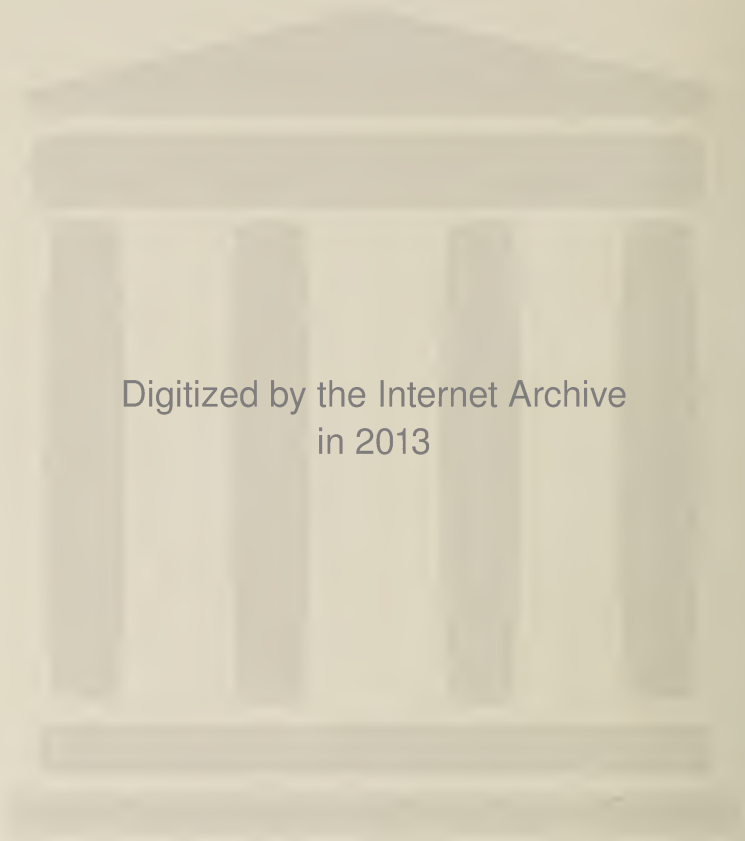


*problem feeds
for livestock
and poultry
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PROBLEM FEEDS FOR LIVESTOCK AND POULTRY IN CANADA

J. W. G. Nicholson and R. E. McQueen

Research Station, Fredericton, N.B.

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INTRODUCTION

Large quantities of feeds are damaged each year by crop disease, unfavorable weather during growth or harvest, improper storage conditions, and other means. It is economically undesirable to destroy all such feed, but the limitations of its use as livestock feed must be recognized and steps must be taken to prevent illness or poor performance by animals. There have been many inquiries by farmers about the problem feeds discussed here. In most cases there is no "standard" answer to questions about the safety of the feed or about its feeding value; the feeder must exercise caution when introducing such feeds into the feeding program. The comments in this publication give broad guidelines that will help you to decide what to do with a particular batch of problem feed.

MOLDY FEED

All feed grown under natural conditions contains the spores of molds (fungi). Given the presence of some oxygen, and the right conditions of moisture (over 65% relative humidity) and temperature, the spores will grow and produce moldy or mildewed feed. As the molds grow they use up some of the nutritive value of the feed, and if their growth is rapid, heating can occur and further lower the feeding value. Moldy feed loses 5–25% of its metabolizable energy, depending on the extent of molding. If mold growth is sufficient to be noticeable, it is estimated that the feeding value has been reduced by 10%. Many vitamins including A, D₃, E, K, and thiamine are destroyed by molds.

The spores produced by molds make contaminated feed very dusty to handle. The problem is especially acute with moldy hay, which must be shaken out before feeding. Because of the dust and other factors, moldy feed is often unpalatable and livestock are reluctant to eat when it is first included in their diet.

Most molds do no harm other than reducing the nutritive value of the feed and making it unpalatable. However, some molds produce toxic compounds called mycotoxins, which may cause disease conditions ranging from a slight reduction in performance to death of the animal. Unfortunately there is no way to distinguish between toxic and nontoxic molds by their appearance or color. Even though molds with the ability to produce toxins are present in a feed, they do not always produce mycotoxins. On the other hand, the absence of live toxin-producing molds is not a guarantee that a feed is safe, because dangerous levels of mycotoxins may have accumulated earlier in the storage period.

It is difficult to say whether or not a batch of moldy feed should be offered to animals. You must balance the loss that can occur if the mold

has produced toxins against the fact that only rarely are the levels of toxin high enough to cause problems. Unless there is good reason to suspect high levels, mix the moldy feed with good feed and feed it to only a few of the least valuable animals in the herd. If no disease symptoms appear, you can increase the amount of moldy feed in the mixture. If possible, feed similar animals uncontaminated feed at the same time to provide a comparison. If disease symptoms appear, withdraw the feed and destroy it. There is no practical way of completely removing or destroying mycotoxins in feeds, but heating to 160–180°C or treating with anhydrous ammonia has been reported to reduce the concentration of aflatoxins.

Chemical tests are known for some of the common mycotoxins, but they are too expensive for routine testing of feed samples and at present none of the provincial feed testing laboratories is offering this analytical service. The amount of mycotoxins in feeds depends on many variables including the strains of molds present, temperature, humidity, type of feed, amount of damage to the feed by insects or disease, and the length of time the feed has been spoiling. Contact a veterinarian or district agriculturist if you suspect that mycotoxins are present. They can help arrange for an analysis to be done and also give advice on better management procedures to reduce the chances of the problem recurring.

MYCOTOXINS AND DISEASE

The mycotoxins discussed in this section are those most likely to be encountered in feed. However, there are many others. About 100 molds that have been found to infect growing crops and stored feed produce mycotoxins. Of these, about 20 have been identified with commonly occurring diseases in livestock.

When a moldy feed is contaminated with a high level of a mycotoxin, the livestock affected may show symptoms that help identify the offending toxin. More often the mycotoxins are present in amounts too small to cause the appearance of the classical disease symptoms. In these cases the symptoms are often not noticed but may cause reduced weight gains and milk production, greater susceptibility to other diseases and general stress, and reproductive failure.

Many of the general symptoms are the same for different mycotoxins. Furthermore, some of the symptoms caused by nutritional deficiencies of some vitamins and minerals, or simply by inadequate energy and protein, are similar to those seen when low levels of mycotoxins are in the feed. If you observe disease symptoms that may be due to mycotoxins, consult a veterinarian about getting the feed analyzed for mycotoxins, and meanwhile change to another feed source.

The full extent of losses to the livestock industry caused by mycotoxins is unknown because the effects are variable and often undramatic. However, potentially harmful molds are found everywhere and you must give them as little opportunity as possible to grow in feed. Molds that produce toxins may infect the crop while it is still growing in the field, or the feed may be contaminated if you handle it with dirty equipment, such as augers, or if you put it in contaminated storage areas.

Most molds continue to grow in feed during storage and after milling for livestock rations as long as enough oxygen and moisture are present. It is important to dry the crop in storage quickly in order to stop the further growth of mold, or to ensile it in the absence of oxygen. You can add chemical preservatives, such as propionic acid, at the time of storing feed to reduce the growth of molds. Badly molded feed gives off clouds of spores when it is handled, even if toxins are absent. These spores can lead to a respiratory allergy, known as farmer's lung, in people handling such feed. There are many reasons to practice good management and so reduce the amount of molds on feed. For further information see Agriculture Canada publication 1437, *Spoilage of farm-stored grain by molds, insects and mites in Western Canada*.

Aflatoxins

The best-known mycotoxins in stored grains are the aflatoxins. At least four types of aflatoxins are produced by the molds *Aspergillus flavus* and *A. parasiticus*. These mycotoxins are more common in warmer climates, so they are a greater problem in the United States than in Canada. However, they can be produced in Canada and they may be present in imported feedstuffs.

Symptoms of low-level aflatoxin poisoning in cattle include unthriftiness, dry and cracked muzzles, prolapse of the rectum, fluid accumulation in the abdominal cavity, and fibrosis of the liver. Young animals fed aflatoxins do not develop immunity to diseases and their response to vaccination is impaired. Young animals are more susceptible to aflatoxins than are older animals. Other conditions that are reported to be caused by aflatoxins are diarrhea, hemorrhaging, abortions, deformed or weak young, vitamin A deficiency, and respiratory infections.

Higher levels cause the liver to turn yellow or tan colored, the gall bladder to become enlarged, and the blood vessels to break down and develop fibrous tissue. Aflatoxins are very potent carcinogens, causing cancer in animals fed for a long time on diets containing aflatoxins at as little as 0.5–1.5 $\mu\text{g/kg}$ of feed.

Aflatoxins have been found in corn grain, all other cereal grains, rice, peanut meal, and cottonseed meal. The *Aspergillus* fungi produce greenish yellow spores and develop the most aflatoxin at 11–37°C, temperatures that are often found in damp grain.

Aflatoxins are also of concern to public health. They have been found in the liver, kidneys, and muscle tissues of poultry and swine fed contaminated feed. Milk contains forms of aflatoxins after dairy cattle have eaten contaminated feed. It takes a week for the milk to become free from aflatoxin after cows have stopped receiving the contaminated feed.

Estrogenism

One of the common diseases in swine and poultry caused by mycotoxins in Canada is the condition known as estrogenism. It is produced by the molds *Fusarium roseum* and *F. graminearum*, and several related strains. The main toxic product is zearalenone, and it is a derivative of this that is used as a growth promotant in slaughter cattle.

The main symptoms of estrogenism are precocious sexual development in young female animals (enlargement of the vulva, mammary glands, and uterus), and possible prolapse of the vagina or rectum. The disease may cause abortions in pregnant animals and reduces feed efficiency. It has a feminizing effect on males.

Estrogenism is most likely to occur from use of crops that have been damaged in the field, such as corn that has developed ear rot, or blighted barley. *Fusarium* molds are likely to develop in cool (below 21°C), wet weather. In laboratory studies, higher levels of zearalenone were produced when the grain was kept warm (20–25°C) for 2 weeks and then subjected to cooler temperatures. Thus it is likely that environmental conditions may greatly affect the development of zearalenone. Pigs have a strong aversion to some forms of this mycotoxin and may refuse to eat contaminated feed, or they may vomit if they do eat it.

Ochratoxin

Ochratoxins are highly potent mycotoxins produced by strains of *Aspergillus ochraceus*, *Penicillium viridicatum*, and related strains of fungi. These molds are often present on grains in Canada. In one Saskatchewan study, ochratoxin A was found in 18 out of 29 samples of heated grain tested. Ochratoxin A is the most potent form of this mycotoxin and has a high acute toxicity in ducklings, rats, chicks, and fish. Symptoms of toxicity in chickens and rats are evident at levels as low as 0.2 mg/kg in the feed. At 4.0 mg/kg it causes egg production in hens to stop completely. Other symptoms produced by levels in the 0.2 mg/kg range include kidney and liver damage. Research in Denmark showed that ochratoxin caused a kidney disease in pigs. Older cattle with a functioning rumen can tolerate larger doses of this mycotoxin than can young calves or simple-stomached animals.

Relatively large doses fed to cattle produced diarrhea as well as reduced appetite and milk production but did not cause death.

T-2

T-2 and related toxins are produced by *Fusarium* species of mold, particularly *F. tricinctum*. This family of mycotoxins can cause skin reactions when applied to the skin of experimental animals and most are also acutely toxic when consumed in the feed. T-2 toxin at levels as low as 0.6 mg/kg of body weight will kill 50% of preruminant calves. Although this level is not lethal in older ruminant animals, major outbreaks of mycotoxin poisoning in dairy cattle have occurred when corn and cereal grains matured late or were high in moisture at the time of the first killing frost and were then stored without drying. T-2 toxins more commonly cause problems in northern climates than do aflatoxins. Postmortem examinations show extensive hemorrhages in the intestines, stomach lining, heart, and muscles.

Ergotism

Ergotism is caused by mycotoxins produced by the fungus *Claviceps purpurea*, which produces a fungal mass known as ergot or ergot bodies. This mass replaces the seed or kernel on the head of the plant. Ergot bodies have the same general shape as the seed but they are larger, purple to black in color, and hard. Although it is most common in rye, ergot also infects triticale, wheat, barley, oats, and grasses such as wheat grass, quack grass, smooth brome, wild rye, and blue grasses. Ergot is most prevalent during wet seasons and may be present in greater concentrations near the edge of a field than in the center.

Ergot causes two types of poisoning. One form causes convulsions, staggering, muscle spasms of the hind legs, and sometimes temporary paralysis. This form of ergotism is usually found in sheep, horses, and carnivores but seldom in cattle. Rigor mortis is never complete in animals that have died from the nervous form of ergotism; the muscles remain flaccid and the arteries contain no blood.

The second, or gangrenous, form of ergotism causes lameness that may be followed by the loss of the end of the tail, ears, and perhaps hooves. Loss of these parts is due to a dry form of gangrene caused by impaired circulation and reduced blood supply to the body's extremities. This form of ergotism occurs in cattle and pigs. It may take 2 weeks to 3 months for symptoms to develop. In the meantime, rate of gain, milk production, and reproduction suffer. It is generally considered dangerous to feed any grain containing more than 0.1% of ergot material (10 ergot bodies to a litre). If more ergot is present, you should mix the contaminated grain with clean grain to reduce the concentration. Do not feed ergot-contaminated grain to pregnant animals.

Ergot is different from the other mycotoxins discussed because it only develops before the crop is harvested. The concentration does not increase in storage.

For further information on ergot, see Agriculture Canada publication 1438, *Ergot of grains and grasses*.

Moldy forages

Disease conditions have been reported less often from feeding moldy forages than from feeding moldy grains. This may be due to the species of molds that commonly grow on these two types of feed or, more likely, because the microorganisms in the rumen of cattle, sheep, and goats may detoxify many mycotoxins. Although moldy hay and silage are not often toxic, mold is undesirable because the nutritive value is reduced and the feed is less palatable to the stock. If the temperature rose higher than about 50°C while the mold was growing, the digestibility of the protein is likely to be low. Provincial feed testing laboratories can estimate the reduction in protein digestibility and you should request this analysis for silages and moldy hay.

The clouds of spores that are released when dry, moldy hay is fed can be injurious both to people (causing farmer's lung) and to animals. You can avoid inhaling much of this dust by feeding the hay in the open air or by wearing a face mask.

One condition that may occur as a result of feeding moldy forages is sweet-clover disease. The toxin responsible is dicoumarol and it prevents the blood from clotting so that animals may bleed to death, often internally. If discovered in time, the condition can be cured by high doses of vitamin K. Moldy sweet-clover has to be fed for about 3 weeks before chronic bleeding occurs. Therefore, you must watch animals carefully for several weeks after starting to feed sweet-clover hay or silage that may be moldy. Properly cured and stored sweet-clover is not toxic. Also, some cultivars of sweet-clover, such as Polara, have been selected to have low levels of coumarins (the compounds changed by the molds to the toxic dicoumarols) so that the risk of sweet-clover disease from them is no greater than with other clovers, such as red clover and alsike.

Sheep are susceptible to infection by *Listeria monocytogenes*, which causes a disease known as listeriosis, or "circling disease." Usually some stress factor such as a storm or underfeeding must be imposed to trigger an attack. The responsible organism is widespread and the animals may become infected from a variety of sources. One common source of infection is poorly preserved silage. The organism cannot live at the acid pH (4.5 or below) of well-preserved silage, but it can be found in the outer layers of silage where the pH may be alkaline (above 7). Take great care if you feed moldy or spoiled silage to sheep.

Symptoms of listeriosis include dullness, standing alone away from other sheep, apparent blindness, and walking in circles. The

disease is most common in sheep but also occurs in other animals. If treatment is started early enough the animal may be saved, but when severe clinical symptoms are evident death usually occurs in spite of treatment.

Preventing molding of forage

Moisture and air (oxygen) must be present for molds to grow. It is impossible to prevent oxygen from penetrating hay in normal storage; therefore to ensure successful storage the hay must be dry enough (18% moisture or less) to prevent mold growth. Hay stored with more than 18% moisture should have chemical preservatives added or should be dried with mow driers.

The key to successful storage of silages is to keep air out, because there is always plenty of moisture for mold growth in silage. You can prevent or greatly reduce the penetration of air by use of airtight structures, compacting the silage, keeping moisture levels high, chopping finely, and sealing the surface. When the surface seal is opened for feeding, several centimetres of silage must be removed each day. If you take too little silage from the exposed surface, molds start to grow and cause heating and spoilage of the silage. In warm weather you must remove 8–12 cm per day to prevent spoilage.

FIRE-DAMAGED GRAIN

Each year fire destroys a number of grain elevators and leaves large quantities of smoke- and fire-damaged grain that is unfit for anything but livestock feed. The more fire-damaged grain is charred, the lower its feeding value becomes. Hence, badly burned grain has very little value as feed. A potential danger in feeding grain from any damaged building is contamination with broken glass, nails, or other metal. You can remove these objects by passing the grain through a screen and past a magnet.

Fire-damaged grain can be fed to all classes of livestock and poultry but bear in mind its lower feed value and the danger of contamination. In experiments with such grain, pigs required a week to become used to the taste and odor but turkeys did not need an adjustment period.

LIGHT-WEIGHT GRAIN

Many environmental and disease conditions affect growing plants so that although the grain does not contain any substances harmful to animals, it is light in weight per unit volume. Obviously if animals are fed such grain by volume they will receive lower levels of nutrients than

if they are fed normal grain. Even when light-weight grain is fed by weight the available nutrients, especially energy, may be lower because light-weight grain is higher in the poorly digested hull and bran and lower in readily digested starch. The energy content of heavy-hulled grains such as oats is depressed more than that of grains such as wheat, which have little hull.

Factors such as kernel shape and size, dry matter content, broken kernels, presence of awns, and contamination with chaff, bits of straw, or weed seeds may affect the density measurement without greatly affecting digestibility of the energy. It would be expected that poorly filled kernels, resulting from immaturity at harvest or diseased plants, would have lower digestible energy contents than well-filled grain of similar low weight due to kernel shape or the presence of awns. Because of these factors, you must determine if the low weight per unit volume is due to poor filling or to other causes before you can estimate the feeding value of the grain. If the kernels are shriveled, shrunken, and poorly filled they are likely to be lower in available energy.

If you are feeding cattle or sheep, the amount of forage in the ration may be reduced and replaced with a corresponding amount of digestible energy from light-weight grain. However, with high-producing dairy cows you may have to limit the amount of light-weight grain fed to ensure an adequate energy intake. If the digestible energy is not too low, animals can compensate by increasing their daily feed intake. For poultry and swine, however, it is often necessary to supplement the ration with vegetable oil or animal fat, or to dilute it with other plump, undamaged grain. A cellulose or fiber analysis of the grain by a provincial feed testing laboratory can help you estimate the available energy content. You can then use this value in designing a balanced ration for the class of stock you wish to feed the light-weight grain.

Many experiments have been conducted over the years to try to establish a relationship between the weight per unit volume of grains and their useful energy content. These attempts have been largely unsuccessful with wheat and barley, probably because so many factors affect the weight per unit volume. Work at the University of Guelph suggests for corn that the metabolizable energy value (ME) for adult roosters changes 71 kJ/kg for each change of 1 kg/hL. A report from the United States with lambs suggests that the percentage of total digestible nutrients (TDN%) of corn can be determined from the equation $TDN\% = 78.0 + 0.246 X$, where X is the bulk weight in kg/hL. However, researchers working with rats at the University of Saskatchewan did not find a useful relationship between bulk weight and digestible energy for wheat or barley but they did for oats. The formula for oats is $DE (MJ/kg) = (1.36 + 0.03153 X) \times 4.184$, where X is the bulk weight in kg/hL.

With so many factors affecting bulk weight, there will probably be greater success in relating useful energy content to a chemical factor

such as fiber content or available carbohydrate content. Some research has not been able to establish such a relationship using surveys of wheat and barley samples. However, Salmon and O'Neil at Agriculture Canada's Research Station in Swift Current and at the University of Saskatchewan did find a relationship for frost-damaged wheat. The bulk weights of the four wheats tested ranged from 83.7 to 57.9 kg/hL and crude fiber contents from 2.79% to 4.55%. They found the true metabolizable energy value for adult roosters (kJ/g) = $(4.82 - 0.34 \times \text{crude fiber \%}) \times 4.184$.

There is need for further research to establish the precise relationship between chemical parameters and the useful energy content of grains. On a theoretical basis for swine and poultry, the best single parameter to use would be neutral-detergent fiber. Until these data become available the equations given above can provide approximations of the feeding value of light-weight grains. All the evidence indicates that the useful energy is not reduced to the same extent as the bulk weight. The most important point to remember is to feed the grain according to weight, not volume.

DISEASED GRAIN

Smut

Smut on grain generally has been considered harmless to animals. However, it is suggested that grain containing a lot of smut should be introduced into the ration carefully, using the procedure suggested in the general paragraph on moldy feeds.

Rust

The kernels of rust-infected grain do not fill properly. In this respect they are similar to the kernels of frozen, immature grain. Although rust spores themselves are not toxic, the dustiness produced by large quantities of spores may affect palatability. The suggestions for feeding light-weight grain should be followed for rust-infected grain.

Ergot

See the section on moldy feeds.

Root rots

Yields of cereal grains are often reduced by root rots. These do not affect the wholesomeness of the grain for animals but frequently result

in grain that is light in weight per unit volume. See the section on light-weight grains.

FROZEN OR IMMATURE GRAIN

When grain is frozen or harvested before it is mature, the amount of starch it contains is reduced. Hence immature grain is relatively high in bran and hull and low in available energy. The degree of damage depends on the stage of maturity when frost hits. Wheat that has matured to 60% dry matter or more is not damaged significantly by frost. Provided immature grains are properly dried and stored to prevent molding, they can be fed to all classes of stock. See the section on light-weight grain for feeding adjustments.

SPROUTED GRAIN

Unfavorable weather during the harvest season often causes grain to germinate in the swath and occasionally even before it is cut. Sprouting lowers the yield and the weight per unit volume but the grain is not harmful to livestock. The amount of growth of the sprouts is an indication of the extent of loss in feed value—the longer the sprouts, the greater the loss. The feeding value of sprouted grain is similar to that of light-weight grain caused by other conditions (see the section on light-weight grain). Care must be taken to ensure that sprouted grain is dry enough to store without molding.

POISONOUS PLANTS

Plants poisonous to livestock occur in all parts of Canada. They are of concern mainly on western ranges, where occasional drought and feed shortages may force animals to graze on plants they would otherwise avoid. Stockmen should know the poisonous plants common in their area and take steps to eradicate them from pastures and feed crops. For information see Agriculture Canada publication 1361, *Stock-poisoning plants of Western Canada*.

Prussic acid

Prussic acid (HCN) can be found at dangerous levels in both cultivated and native forages, particularly in new growth after a period

of slow growth caused by drought or frost. Plant material containing HCN at more than 20 mg/100 g is likely to be toxic to cattle and sheep. Two of the most dangerous plants are arrow-grass and choke cherry leaves but toxic levels have been found also in flax, sorghum, bird's-foot trefoil, and corn. The poisonous substance, prussic acid, is present in the plant as a chemical complex with a sugar moiety (glycoside) and becomes dangerous when it is hydrolyzed to free the prussic acid during digestion. The level of the toxin is reduced when the plants are cured as hay or stored for a few weeks as silage.

Symptoms of prussic acid poisoning include nervousness, abnormal breathing leading to respiratory failure, and muscle spasms. The blood remains bright red in contrast to the brown color seen in nitrite poisoning, but other symptoms are similar. Death may occur quite quickly. If diagnosed in time the animals can be treated by an intravenous infusion of sodium nitrite and sodium thiosulfate and by surgically emptying the rumen. Horses and pigs are less susceptible to poisoning by the glycosides than are cattle.

Although prussic acid poisoning is not common, take care not to turn hungry cattle into fields of sorghums or legumes that are growing rapidly after a period of drought or a frost.

Nitrates and nitrites

Nitrates (NO_3) may accumulate to toxic levels in crops when rapid growth has been interrupted by lack of moisture or light, or by frost, particularly when the crops have been heavily fertilized with nitrogen. Green oat hay often has high levels of nitrate, causing the disease commonly called oat hay poisoning. Some plants, such as redroot pigweed and lamb's-quarters, accumulate nitrates after they have been sprayed with sublethal doses of 2,4-D and 2,4,5-T. Toxic amounts of nitrates may occur in water that receives runoff from heavily fertilized fields or barnyards. Fertilizer bags left lying around where animals can lick them have caused death from nitrate poisoning. Ruminant animals are more likely to show toxic symptoms than nonruminants because nitrates are changed in the rumen to the more dangerous nitrites (NO_2). Nitrites interfere with the ability of the blood to carry oxygen and in severe cases cause death in 3–5 hours. Symptoms include rapid breathing and heart rate, diarrhea, weakness, and staggering. The mucous membranes may be bluish and the urine may be dark. The blood has a brown color.

Animals seem to adjust to moderate levels of nitrate if the feed is introduced gradually into the diet. Also, feeding a high-energy feed provides more readily available energy to aid the rumen microorganisms in utilizing the nitrate nitrogen before it can be absorbed.

If the condition is diagnosed early enough, animals can be treated by intravenous infusion of methylene blue or by surgically emptying the rumen.

PESTICIDE RESIDUES

Many pesticides currently used to control diseases and insects on crops are less persistent and less toxic to animals than those in use previously. Because of this, there is less danger of animals actually being harmed by consuming crops treated with common pesticides. On the other hand, there is danger of pesticide residues being accumulated in the tissues or milk of animals fed treated crops. For this reason you should not feed crop residues (such as pea vines, beet tops, cull carrots, or apple pomace) treated with pesticides unless the pesticides are specifically approved for use on feed crops. If in doubt, consult the local advisory service.

Never feed leftover seed grain that has been treated for disease control. If grain augers have been used to treat seed or to move treated seed, be sure they are cleaned thoroughly before they are used to move feed.

MISCELLANEOUS

It is not possible to cover every possible problem feed in detail; some that are well known and others that occur only occasionally are mentioned briefly in this section.

Legumes

Many farmers hesitate to use legume stands for pasture because of bloat. Precautions to reduce the danger include pasturing the animals for short periods of time, feeding grass hay on the pastures, and administering a bloat preventative.

Some legumes contain enough phytoestrogens to upset the reproductive cycle in animals pastured on them.

Sunburned and sprouted potatoes

Potatoes that are sunburned and potato sprouts contain toxic glycoalkaloids. No problem occurs when the normal proportions of sunburned potatoes are fed to cattle with the other culls from a grading operation. Also, sprouted potatoes coming directly from a dark storage are unlikely to cause problems provided the animals are not forced to consume large amounts of sprouts. Sprouts that have been removed from potatoes should not be fed, nor should sprouted potatoes that have been exposed to light.

Raw soybeans

Raw soybeans contain factors that reduce the nutritional value of feeds and should not be fed to simple-stomached animals such as pigs and poultry. Ruminant animals can tolerate raw soybeans in the diet provided urea is not included in the grain mixture. Because of the high oil content, whole soybeans should not be processed very long before feeding or they will spoil.

Beet tops

The oxalic acid content of sugar beet tops has occasionally caused problems. You can prevent these problems by feeding extra ground limestone (about 100 g/day for beef calves).

Oilseed screenings

Occasional cases of copper toxicity have been encountered in sheep fed high levels of oilseed screenings. Cattle are affected less often than sheep because they are less sensitive to copper toxicity.

Newly harvested grain

There is no known reason why newly harvested grain should cause problems. However, there have been reports of severe losses on occasion and many feeders refuse to use new grain until after a month or so of storage.

High-silica grasses

Certain native grasses contain high levels of silica and may cause urinary calculi (stones) which block the urinary tract of male animals. You can prevent the stones from forming by feeding extra salt to force the animals to consume more water and dilute their urine.

WATER

Not all water is suitable for livestock to drink. The problems with water are usually regional in nature and vary from area to area. Treatment to make the water drinkable may be possible, depending upon the cause of the problem.

Algae growth in ponds, dugouts, or sloughs develops during hot summer weather. A sudden change in environment can cause the death and decomposition of the algae; this situation in turn causes a

depletion of oxygen and death of fish. It also can give the water an offensive odor and taste. Certain types of blue-green algae are highly toxic and can cause death of animals that drink the water.

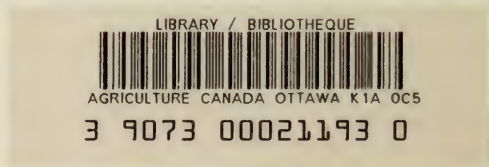
Algae growth can be kept to a minimum by limiting the quantities of nutrients that enter the pond through leaching of fertilizers or runoff from feedlots. The banks should be stabilized to prevent erosion and the oxygen content of the pond should be kept as high as possible. To help maintain a high oxygen count, design the channel carrying water into the pond so that the water flows over rocks or over small man-made waterfalls. Where this is not possible, use an irrigation pump to draw water from one end of the pond and to spray it as a fountain at the opposite end.

Although algae growth can be minimized by keeping the nutrient level low and the oxygen level high, it may still be necessary to treat the water to destroy algae. Several chemicals are sold for this purpose. The oldest treatment is to add a solution of copper sulfate (bluestone) at the rate of 1 mg of bluestone for each litre of water in the pond.

All water used for livestock contains dissolved minerals, which may contribute significantly to the animals' intake of these minerals. Occasionally some minerals may be present in toxic quantities. Several ways have been used to describe the amount of minerals dissolved in water. Hardness is a description of the tendency of water to precipitate soaps. It depends largely on the amount of calcium and magnesium salts present and is not very useful as a criterion of the suitability of the water for livestock. Salinity is a measure of the amount of sodium salts in water and this gives a better indication of the acceptability of water to livestock.

A thorough discussion on water quality for animals can be found in the booklet *Nutrients and toxic substances in water for livestock and poultry* published in 1974 by the National Academy of Sciences, Washington, D.C. In summary, they recommend that waters containing more than 10 g of dissolved salts to a litre not be used for livestock under any circumstance. Water with less than 3 g/L should be suitable for all classes of livestock. Water containing between 3 and 10 g/L should not be used for poultry and should be used with caution for other classes of livestock, especially pregnant or lactating animals and those exposed to heat stress.

Some waters which contain an acceptable level of total dissolved minerals may contain toxic levels of some elements. The table presented here is from the National Academy of Science booklet cited in the previous paragraph.



Recommended limits of concentrations of some potentially toxic substances in drinking water for livestock and poultry

Mineral	Safe upper limit (mg/L)
Arsenic	0.2
Cadmium	0.05
Copper	0.5
Fluoride	2.0
Lead	0.1
Mercury	0.01
Nickel	1.0
Nitrate-N	100
Nitrite-N	10

CONVERSION FACTORS		
Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	x 0.04	inch
centimetre (cm)	x 0.39	inch
metre (m)	x 3.28	feet
kilometre (km)	x 0.62	mile
AREA		
square centimetre (cm²)	x 0.15	square inch
square metre (m²)	x 1.2	square yard
square kilometre (km²)	x 0.39	square mile
hectare (ha)	x 2.5	acres
VOLUME		
cubic centimetre (cm³)	x 0.06	cubic inch
cubic metre (m³)	x 35.31	cubic feet
	x 1.31	cubic yard
CAPACITY		
litre (L)	x 0.035	cubic feet
hectolitre (hL)	x 22	gallons
	x 2.5	bushels
WEIGHT		
gram (g)	x 0.04	oz avdp
kilogram (kg)	x 2.2	lb avdp
tonne (t)	x 1.1	short ton
AGRICULTURAL		
litres per hectare (L/ha)	x 0.089	gallons per acre
	x 0.357	quarts per acre
	x 0.71	pints per acre
millilitres per hectare (mL/ha)	x 0.014	fl oz per acre
tonnes per hectare (t/ha)	x 0.45	tons per acre
kilograms per hectare (kg/ha)	x 0.89	lb per acre
grams per hectare (g/ha)	x 0.014	oz avdp per acre
plants per hectare (plants/ha)	x 0.405	plants per acre

